# Report for the Joint Use/Research of the Institute for Planetary Materials, Okayama University for FY2024

05/13/2025

Month/Day/Year

**Category:** ☑International Joint Research ☐General Joint Research ☐Joint Use of Facility

☐Workshop

**Name of the research project:** Experimental investigation of the effect of temperature/stress on the lattice preferred orientation of bridgmanite

**Principal applicant:** Guan Longli

**Affiliated institution and department:** State key laboratory of geological processes and mineral resources, China University of Geosciences (Wuhan), Wuhan, China

**Collaborator**

**Name:** Daisuke Yamazaki

**Affiliated institution and department:** Institute for Planetary Materials, Okayama University

**Research report:**

1) Please write the research report with free format, but include followings: research purpose, actually conducted research, and research outcomes. If necessary, you can add another page.
2) For the workshop, please write the report for the workshop. Also, attach the program, abstracts, and list of the participants etc.
3) Please add Collaborator's Name, Affiliated institution and department as needed.
4) Please answer the question on the next page.

Seismic anisotropy has been widely observed in the lower mantle. The lattice preferred orientation (LPO) of bridgmanite is the most plausible origin for these seismic observations. However, previous studies show inconsistent results about the LPO of bridgmanite at 1773 to 2130 K. Therefore, the first purpose is to investigated the effect of temperature on the lattice preferred orientation of bridgmanite.

I performed the four simple shear deformation experiments on Al-bearing bridgmanite aggregates (starting samples were synthesized in Misasa during the last visit) at 1700-2000 K and 25 GPa by using the D111-type apparatus with 6.5/2 cell. The experimental run numbers are: D132, D134, D136, D138. The shear strains were between 0.4~1. After the microstructure observation, I double-polished the samples for the LPO measurement. The LPO was obtained through the two-dimensional (2D) monochromatic X-ray diffraction pattern method at BL04B1 of synchrotron facility of SPring-8, Hyogo, Japan. The LPO of bridgmanite changed with temperature: (100) at low temperature and (010) at high temperature. The transition temperature was about 1800 K for Fe-free and Fe-bearing bridgmanite, but shifted to ~1950 K for the Al-bearing (Tschmark type substitution mechanism). However, the LPO of Al-bearing bridgmanite (oxygen vacancy type substitution) changed from (100) at 1700-1900 K to (010) at 2000-2100 K. The transition temperature was ~1950 K.

For the second purpose for this visit is to investigate the Fe effect on the creep strength of bridgmanite. I synthesized Fe-free and Fe-bearing bridgmanite with 10/4 and 10/5 cells at ~23 GPa and ~2100 K by using 1000-ton multianvil high-pressure apparatus. In total, seven synthesis experiments were conducted (1k3878, 1k3879, 1k3880, 1k3882, 1k3898, 1k3900, 1k3907). The Fe-free and Fe-bearing bridgmanite were then used in the deformation experiments performed in SPring-8 (M4364, M4365, M4369, M4378, M4384) to investigate the Fe effect on the creep strength of bridgmanite. The results showed that incorporating of Fe can make bridgmanite a bit softer.